IBOM MEDICAL JOURNAL
Vol.18 No.2 | April - June, 2025 | Pages 363 - 369
www.ibommedicaljournal.org

Prevalence of hypertension and microalbuminuria in children of hypertensive and non-hypertensive parents in Calabar, Nigeria: A comparative study

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Abstract

Background: High blood pressure (HBP) and microalbuminuria are common in children of parents with hypertension. Microalbuminuria is a strong predictor of early stage hypertension as well as kidney injury.
Objective: This study therefore aimed to determine the prevalence of HBP and microalbuminuria among children of hypertensive parents.
Methods: This was a comparative study involving 176 children aged 6-15 years of hypertensive parents attending the hypertension clinic of the University of Calabar Teaching Hospital (UCTH) and 176 children aged 6-15 years of normotensive health workers. Blood pressure, anthropometric indices were measured. Also, body mass index (BMI) and waist –hip-ratio (WHR) were calculated according to standard protocols. Urine albumin-to-creatinine ratio (UACR) on a spot early morning urine sample obtained from all the participants was measured. Subjects with UACR >20-30mg/g were taken as having microalbuminuria. Data were analysed using SPSS version 25.0, with significant p-value set at 0.05.
Results: Five (2.8%) out of 176, of the subjects had high BP, while one (0.6%) out of 176 of children of normotensive parents had HBP. The difference in prevalence was not statistically significant (p=0.061). There were no differences in the BMI and WHR in the two groups. None of the children in the study had microalbuminuria. However, mean urine albumin: creatinine ratio was higher in the subjects compared with controls.
Conclusion: The prevalence of high BP among children of hypertensive parents was not significantly higher than that of children of normotensive parents and none of them had microalbuminuria.

Key words; hypertension, microalbuminuria, normotensive, prevalence

Introduction

High blood pressure (BP) in children and adolescents is a growing health problem and an established modifiable risk factor of cardiovascular morbidity and mortality.[1] The link between cardiovascular risk factors both in children and adults with parental history of cardiovascular diseases had been established.[2,3] Children and adolescents with family history of hypertension have a high risk of experiencing hypertension themselves.[2] For instance, a positive family history of hypertension in at least one parent is considered a risk factor in offspring.[2] A study[3] showed that among young normotensive subjects, BP of children of normotensive parents were found to be lower than children of hypertensive parents taken within a physician office environment. Kurnianto et al[4] established that the prevalence for high BP doubles with a record of family history of hypertension. A 41.9% prevalence rate of high BP

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DOI: 10.61386/imj.v18i2.677

was established among children and adolescents with either one or both hypertensive parents compared to normotensive subjects.[4]

In Nigeria, a prevalence of hypertension of 5-13% has been reported in children.[5-8] Globally, data from the Centre for Disease Control and Prevention (CDC) and National Centre for Health Statistics (NCHS) spanning 2015-2016 showed a hypertension prevalence of 4-15% in children aged 17 years and below.[9] The rising incidence of hypertension in children in various countries is getting more significant, and calls for interventions to remedy the situation.[6]

High BP in children is rarely diagnosed because physicians do not routinely check BP of children. This is one of the reasons why high BP in children is usually diagnosed with target organs damage. The kidneys and the heart are the early target organs in children as most of them are asymptomatic.[10,11]

Microalbuminuria is a known predictor of increased renal and cardiovascular risk associated with hypertension.[12] Microalbuminuria refers to the excretion in urine of very small quantities of albumin in excess of 20µg/minute. It is defined as excretion of levels of albumin ranging from 30 to 299mg/24 hour, which typically correlates to a microalbumin: creatinine ratio of >20 to 30mg/g creatinine on a spot urine specimen.[13]

Studies[9,10] have shown that microalbuminuria is commonly encountered in hypertensive as well as normotensive offspring of one or both hypertensive parents. Though the mechanism of microalbuminuria in hypertension is not clearly understood, it is suggested that vascular endothelial dysfunction or renal damage may be responsible.[14,15]

It is hypothesized that microalbuminuria can signal the risk of development of cardiovascular disease in apparently healthy people. This finding can be exploited as an early indicator or marker of early stage hypertension in individuals with family history of parental hypertension. In a study conducted by Matjuda et al[16] to investigate the relationship between high BP and microalbuminuria in 6 -9 years old rural and urban South African children, they reported a prevalence of 42.8% and 10.1% respectively of high BP and microalbuminuria. A similar study[17] among secondary school children aged 10-19 years using micral test strips in Nigeria showed that of the 33.3% of the children with microalbuminuria, 59.5% had a family history of hypertension and among the children with hypertension, 70.6% had microalbuminuria. These studies[16,17] used semi-quantitative test. This index study was therefore conducted to compare the prevalence of hypertension and microalbuminuria in children of hypertensive and normotensive parents in Calabar, Nigeria using a quantitative test of albumin/creatinine ratio.

Subjects and methods

Study area: This study was conducted in Calabar, Cross River State, Nigeria, earlier described by Ineji et al.[18]

Study design: The study was a cross sectional comparative study.

Study population: Children aged 6-15 years of hypertensive parents diagnosed more than six months attending the hypertension clinic of the University of Calabar Teaching Hospital (UCTH), Calabar and children aged 6-15 years, age and gender matched of health workers in UCTH who are normotensive, whose parents consented to the study. Children with known history of chronic diseases such as diabetes mellitus, renal disease or endocrine disorders, urinary tract infection(UTI), cigarette smoking and females menstruating were excluded from the study. Home visits for children who met the inclusion criteria was done during the weekends or at their parents' convenience.

Methods

Information regarding bio data, personal and family history of hypertension, diabetes mellitus, renal disease, cigarette smoking, history suggestive of UTI, menstrual history for girls and recent febrile illnesses were obtained. Anthropometric measurements, including weight, height, body mass index (BMI), hip circumference, waist/hip ratio (WHR) were calculated using standard protocols and blood pressure were measured as recommended by the updated Clinical Practice Guideline by the American Association of Pediatric (AAP) 2017[19] on the diagnosis, evaluation and treatment of high blood pressure in children and adolescents. Subjects were made to sit relaxed for about 5 minutes. Blood pressure (BP) was taken using a standard mercury sphygmomanometer, ACCOSON England, with

age appropriate cuff sizes. Readings were taken at the first and fifth Korotkoff sounds as recommended by the (AAP) 2017[19] Guideline.

Each subject had three readings taken at intervals of five minutes and the averages of the readings taken as the blood pressure of the individual. SBP or DBP of 90th to 94th percentile was classified as elevated BP while values equal to or greater than the 95th percentile for age, sex and height was classified as hypertension respectively as recommended by the (AAP) 2017[19] Guideline.

Written instructions were given to the parents on how to obtain specimen. The urine specimen was collected from the subjects with the help of their parents for those younger than 10 years. The UACR was measured based on a spot early morning urine sample obtained from the subjects. The collected urine specimens were tested promptly for protein by dipstick urinalysis, while the urinary albumin and creatinine estimation for the calculation of the UACR was determined as follows: First, urine albumin estimation was done using the turbidimetric method and urine creatinine estimation done using a commercially available colorimetric test kit produced by Biolabo® (Biolabo SA, 02160, Maizy, France) which is based on modified Jaffe Kinetic method.[20] The presence of microalbuminuria was defined as a UACR of >20 -30mg/g on a spot urine specimen and overt proteinuria as a UACR of greater than 30 mg/g.

The children were grouped into social economic classes using the mothers' educational level and fathers' occupation as suggested by Olusanya et al[21] Social class I and II were taken as upper class, III as middle class and IV and V as lower class.

Data analysis

Data obtained from the questionnaires was coded into Micro Soft Excel 2010 and imported into IBM Statistical Package for Social Science (SPSS) version 25.0 for analysis. Categorical variables were analysed and presented as frequencies, percentages and charts, while continuous variables were analysed and presented as mean, standard deviation, median and interquartile range as appropriate. The Kolmogorov-Smirnov test was used to test for normality. Significant level of the variables was considered for a p-value <0.05.

Ethical consideration

Ethical approval was obtained from the Ethics and Research Committee of the UCTH, Calabar .

Results

A total of 352 children aged 6 to 15 years participated in the study out of which 176 were subjects while the remaining 176 were controls. In the overall, male children were slightly higher in proportion compared with female children (51.1% versus 48.9% respectively), and the proportion of males was higher among subjects compared with that of controls, but the difference was not statistically significant (p=0.831) as seen in Table I. The male-to-female ratio was 1.05:1.00. There was no statistically significant difference between the

Table I: Comparison of socio-demographic/characteristics of children and their parents by blood pressure status

Variable	Study group: Subjects n=176	Controls n=176	Total N=352	Chi square test	P value
Sex of children					
Male	91(51.7)	89(50.6)	180(51.1)	.045	0.831
Female	85(48.3)	87(49.4)	172(48.9)		
Age group of children/years					
6-10	90(51.1)	87(49.4)	177(50.3)	.102	0.749
11-15	86(48.9)	89(50.6)	175(49.7)		
Mean age ±SD	10.4±2.8	10.5±2.8	10.4±2.8	t-test,0.111	0.912
Parent's age/years					
28-37	6(3.4)	27(15.3)	33(9.4)	3.393	0.335
38-47	98(55.7)	104(59.1)	202(57.4)		
48-57	59(33.5)	41(23.3)	100(28.4)		
58-67	13(7.4)	4(2.3)	17(4.8)		
Mean age ±SD	45.0±6.5	44.5±6.2	44.7±6.7	t-test,0.798	0.425
Socioeconomic class					
Upper class	74(42.0)	77(43.8)	151(42.9)	1.950	0.377
Middle class	73(41.5)	79(44.9)	152(43.2)		
Lower class	29(16.5)	20(11.4)	49(13.9)		

Table II: Prevalence of high blood pressure among subjects and controls

Variable	Study group: Subjects n=176	Controls n=176	Total N=352	Test Statistics	P value
Systolic BP/mmHg					
Normal	171(97.2)	175(99.4)	346(98.3)	FET	0.215
High	5(2.8)	1(0.6)	6(1.7)		
Mean SBP±SD	100.4±11.5	97.7±10.9	99.1±11.2	t-test;2.289	0.023*
Diastolic BP/mmHg					
Normal	171(97.2)	176(100.0)	347(98.6)	FET	0.061
High	5(2.8)	0(0.0)	5(1.4)		
Mean DBP±SD	62.2±9.6	59.3±8.6	60.8±9.2	t-test;2.997	0.003*

FET=Fisher's Exact Test; "*"=statistically significant, SD= Standard deviation

Table III: Risk factors and high blood pressure among study participants stratified by study group

	Subjects (n=176) High blood pressure			Controls (n=176) High blood pressure		
Variable	**Absent n=171**	**Present n=5**	**FET (p-value)**	**Absent n=175**	**Present n=1**	**FET (P Value)**
Age group of children/years						
6-10	88(97.8)	2(2.2)	FET (0.677)	87(100.0)	0(0.0)	FET (1.000)
11-15	83(96.5)	3(3.5)		88(98.9)	1(1.1)	
Sex of children						
Male	89(98.8)	1(1.2)	FET (0.203)	83(100.0)	0(0.0)	1.000
Female	82(95.3)	4(4.7)		92(98.9)	1(1.1)	
Mean weight/kg	40.7±11.6	47.8±16.5	t-test (0.189)	40.8±11.7	48.0±0.0	t-test (0.542)
Mean height/m	1.4±0.1	1.5±0.2	t-test (0.379)	1. 5±0.1	1.6±0.0	t-test (0.451)
Mean BMI (kg/m²)	18.5±2.6	20.0±4.0	t-test (0.185)	18.7±2.8	19.7±0.0	t-test (0.717)
Waist circumference (cm)	63.1±6.9	69.2±11.2	t-test (0.059)	63.9±7.2	65.0±0.0	t-test (0.881)
Hip circumference (cm)	75.9±9.6	82.0±0.8	t-test (0.170)	76.2±9.2	78.0±0.0	t-test (0.844)
WHR	0.8±0.04	0.8±0.05	t-test (0.512)	0.8±0.03	0.8±0.0	t-test (0.823)

Table IV Microalbuminuria and urine albumin-to-creatinine ratio (UACR) among subjects and controls

	Study group				
	Subjects n=176	**Controls n=176**	**Total N=352**	**Student t-test**	**P Value**
Microalbuminuria (UACR >20-30mg/g)					
Present	0(0.0)	0(0.0)	0(0.0)		
Absent	176(100.0)	176(100.0)	352(100.0)		
Mean UACR±SD	0.028±0.04	0.012±0.01	0.020±0.03	4.632	<0.001*
Median/IQR	0.0179/0.03	0.0088/0.01	0.112/0.02		

UACR = amount of urine albumin divided by creatinine levels in urine

Table V: Relationship between blood pressure and urine albumin-to-creatinine ratio (UACR) stratified by study group

		Study group			
		Subjects (n=176)		**Controls (n=176)**	
		Systolic BP	Diastolic BP	Systolic BP	Diastolic BP
UACR	Pearson Correlation**	0.01	0.09	0.	0.14
	P Value	0.928	0.246	0.172	0.071
	N	176	176	176	176

Pearson Correlation**=Used for continuous data

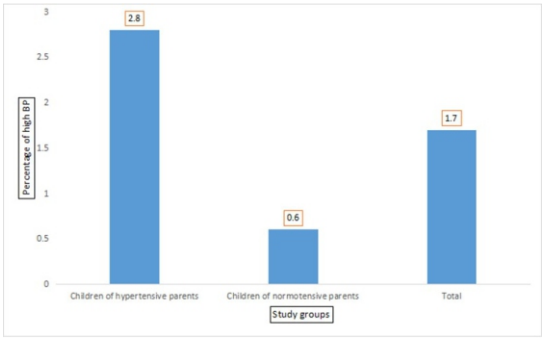

Figure i: Prevalence of high blood pressure among children aged 6 to 15 years (p=0.061)

groups under comparison regarding age group of children (p=0.749), mean age of parents (p=0.425) and socioeconomic class (p=0.352). In Table II mean SBP among subjects was 100.4±11.5 mmHg, while that of controls was 97.7±10.9 mmHg, and the difference was statistically significant (p=0.023). The proportion with normal SBP was 171 (97.2%) among subjects, and higher among controls (99.4%), although the difference was not statistically significant (p=0.215). In Table III the overall prevalence of hypertension was 1.7%, among subjects, the prevalence was 2.8%, while among the controls, the prevalence was 0.6%.This difference was not statistically significant (p=0.061). More females than males, were hypertensive, and hypertension was commoner among the older age group. In Table IV, none of the children in the study had microalbuminuria (UACR >20-30mg/g). However, mean urine albumin: creatinine ratio was higher in the subjects compared with controls (0.028±0.04 versus 0.012±0.01), and the difference was statistically significant (p<0.001). Median/Interquartile range (IQR) value was higher among subjects (0.0179/0.03) compared with that of controls (0.0088/0.01) as seen in Table V.

Discussion

The prevalence of high BP among children of hypertensive parents in this study, though not significantly higher, nonetheless showed a higher frequency of occurrence, than those of normotensive parents. It is a known fact that children of hypertensive parents are more prone to higher BPs than those of normotensive parents.[22-25] Fitriany et al[22] found a high correlation between parental hypertension and high BP in the children. The higher prevalence of hypertension found among children of hypertensive parents have been attributed to a number of factors including the interplay of genetic and environmental factors in the possible aetiology of elevated BP.[24,26] For instance, high salt intake has been associated with sustained high BP and since these children share in this dietary habit it may be contributory.[24] However, in this

study, salt intake of children was not assessed and more studies are needed to prove this assertion. From the current study, SBP and DBP were higher among subjects compared with controls and the difference was statistically significant. This was similar to the study by Ramya et al[26] where SBP was significantly higher among children of hypertensive parents compared with children of normotensive parents, but DBP did not show any significant difference between the groups.

The proportion of elevated BP was higher in the relatively older age group (11-15 years) compared with the younger age group (6-10 years). This is in agreement with the known fact that BP increases with age until it plateaus.[7,27] The proportion of children who had high BP was more among females compared with males. This is similar to studies by Borah et al[28] and Ibrahim et al,[29] who found high BP in females compared with males. The reason for the finding in this study may be attributed to high BMI and hormonal effect in females compared to their male counterparts. However, this is in contrast to work done by Lurbe et al[30] where high BP was found to be greater among boys compared with girls, however, BP was found to increase with age as also found in the current study. Another study also found BP to be higher in males compared with females.[31] In this study, BP was taken by the same researchers thus eliminating inter observer differences. In addition, it is known that androgen levels increase during adolescence and puberty and this plays an important role in sex- associated differences in BP regulation.[32] In this study, none of the subjects or controls had microalbuminuria. This finding is similar to the study by Gerstein et al[32] who found no significant difference in microalbuminuria between control and those with high blood pressure. This was however different from the study conducted by Ibadin et al[33] which showed a microalbuminuria prevalence of 19% and 8% in adolescents and young adults offspring of hypertensive parents and controls respectively. But Okpere et al[17] found a microalbuminuria prevalence of 33.3% among secondary school students in Port Harcourt, Nigeria. These high values may be attributed to the method of urine collection the methods used to assess for microalbuminuria. In this study, quantitative assay of microalbuminuria using turbidimetric method was done and this is known to be superior to micral strips in sensitivity and specificity, in detecting microalbuminuria as was used in the former studies.[17,34] In addition, the differences in prevalence could be due to difference in cut off points used by different researchers in defining microalbuminuria, difference in age groups of study participants, physical activities as well as comorbidities such as obesity. In this study, participants collected their urine sample early in the morning when they had not engaged in any physical activity also none of the participant had obesity. Nonetheless, in this study, the mean urine albumin-to-creatinine ratio was higher among subjects compared with controls, though the difference was not statistically significant. Median/Interquartile range value was also higher among subjects compared with controls. This finding supports earlier studies[17,33] that children of hypertensive parents of African descents have high predisposition to microalbuminuria than children of normotensive parents, age and sex matched. It is also in agreement with previous studies that microalbuminuria is positively associated with the pathogenesis of hypertension.[16,27] In view of this, microalbuminuria could serve as a strong predictor of hypertension in children of hypertensive parents.This study found a positive relationship between UACR and DBP, (p=0.019). Among the children of hypertensive parents, there was a positive relationship between UACR and both SDP and DBP, but it was not statistically significant (p=0.928), (p=0.246). Among controls, there was also a positive relationship between UACR and SBP/DBP, but the relationship was not statistically significant. The reason for this finding could be that though under normal circumstances there should be undetectable urinary excretion of albumin, but when present it predicts onset of high BP. This finding agrees with that of a study carried out by Gerstein et al[32] who also found no significant difference in microalbuminuria between control and those with high BP. Furthermore, high prevalence of microalbuminuria was found to be more common in children of one or two hypertensive parents.[33] Any level of increased UACR is said to be closely associated with the risk for developing high BP in the general population. A study[16] done among South African children showed that SBP was associated with UACR and increased

SBP predicted microalbuminuria. This was attributed to renal or vascular damage due to high BP. In this study early morning spot urine sample was used to determine UACR. It has been observed that mobility affects secretion of albumin and since the samples were collected after sleep it was not surprising that there was no microalbuminuria. However, the limitation to this finding was that sodium intake was not assessed in this study since dietary sodium intake influences both microalbuminuria and high BP.[27,35]

Conclusion

In conclusion, children of hypertensive parents were found to have higher blood pressure and also more at risk of microalbuminuria when compared to their sex and age matched counter parts of normotensive parents. Findings also suggest that microalbuminuria may serve as a useful indicator for early prediction of hypertension in children of hypertensive parents.

Funding: No funding was received for this study

Conflict of interest: There is no conflict of interest with regards to this study.

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